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# THE POLE-FRAME BRUSH DAM— A LOW-COST MECHANICAL AID IN REFORESTING GULLIED LAND

by

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The Occasional Papers of the Southern Forest Experiment Station present information on current southern forestry problems under investigation at the Station. In some cases these contributions were first presented as addresses to a limited group of people, and as "occasional papers" they can reach a much wider audience. In other cases, they are summaries of investigations prepared especially to give a report of the progress made in a particular field of research. In any case, the statements herein contained should be considered subject to correction or modification as further data are obtained.

# THE POLE-FRAME BRUSH DAM- A LOW-COST MECHANICAL AID IN REFORESTING GULLIED LAND

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Extensive erosion-control projects undertaken in the Southern States during the past 5 years demonstrate that even large, actively eroding gullies in this region can be stabilized and controlled eventually by planting them to trees and other hardy soil-binding plants. Commonly in these operations, small temporary check dams are constructed in the gullies to collect and build up deposits of productive soil outwash on which the vegetation can gain a suitable foothold. These simple structures usually are built of rather temporary materials and, unlike the stronger and more permanently constructed types of check dams, are designed primarily to improve the growing site for vegetation rather than to afford long-term mechanical protection to the gully channel. In the South, these temporary dams generally are used in gullies with relatively small drainage areas rarely exceeding a few acres in extent, although the gullies themselves may be very large and actively eroding and may carry a comparatively great flow during storms. When temporary check dams are used, the vegetation obviously must be depended on to stabilize the bottom of the gully channel within the life of the materials—usually 3 to 5 years.

Many types of check dams have been used. Ordinarily they are constructed of straw, brush, logs, loose rock, woven wire, or other inexpensive materials readily obtainable. In the Gulf States the scarcity of straw and rock largely precludes the use of these materials, and although woven-wire dams of several types have been employed widely, the nominal cash outlay required to build them has tended to limit their use by farmers and landowners. Log dams, when properly constructed, are sturdy and dependable, but they are likely to be wasteful of materials and are time-consuming to build. On the other hand, brush dams are favored generally because they can be constructed easily and quickly from inexpensive materials available on most gullied areas.

Perhaps the most simple type of brush dam is that formed by laying brush boughs crosswise of the channel and weighting the brush mass down with logs. These simple brush barriers, which were used as early as 1915 by Maddox[1] in reforesting gullied lands in western Tennessee, have proved very effective in mature gullies that have formed on moderate slopes and that do not drain large areas or carry excessive quantities of run-off.

On most present-day projects, more sturdily constructed dams, designed to withstand relatively great flow, are favored. The two most widely employed types are: (1) the <u>longitudinal or parallel dam</u> with the brush laid lengthwise of the channel and anchored with posts and wire or with staked poles; and (2) the <u>double row-post dam</u> with the brush laid crosswise of the gully between a

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1/ Maddox, R. S. Reclamation of waste lands. Tenn. Div. Forestry Circ. No. 10, 10 pp., illus. October 1926.

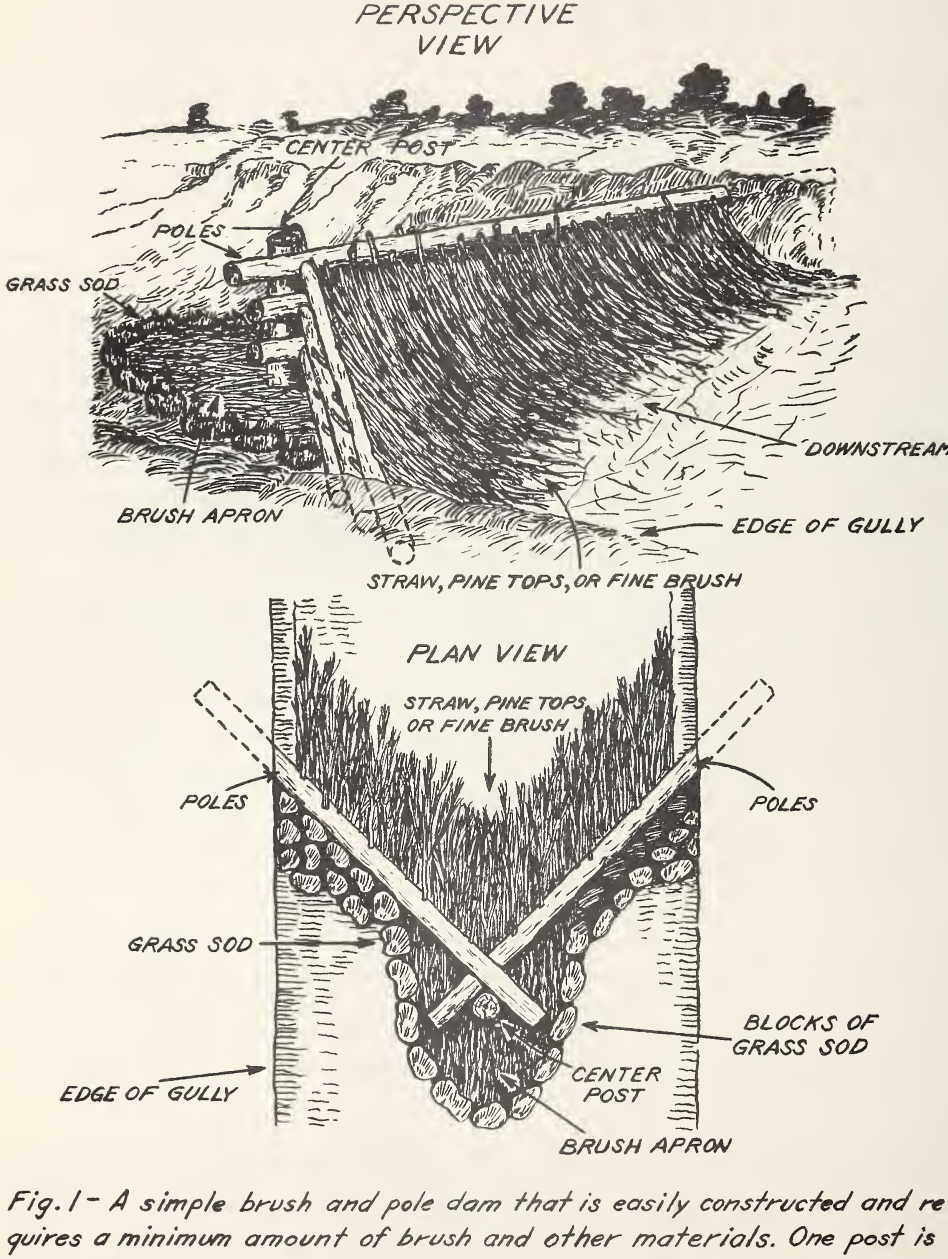


*Fig. 1 – A simple brush and pole dam that is easily constructed and requires a minimum amount of brush and other materials. One post is set in the center of the drainage and a frame work of notched poles laid against this. Straw, pine tops, or fine brush is packed against the upper face. A brush and sod apron protects the base of the dam at the point where the flow is concentrated. The ends of the dam are embedded securely in the gully banks and the lower pole is embedded in the gully bottom.*

double row of posts and held in place by wire ties.[2] The parallel dam is used commonly in narrow, head-feeder gullies, whereas the crosswise dam is favored in the larger, wider washes. The latter, when properly constructed, is perhaps the sturdiest of all the well-known types of brush dam.

A type of brush dam that has proved highly dependable, and which has certain features that recommend its use on projects involving the reforestation of low-value gullied lands, was developed by the writer in 1932 in connection with early studies carried on by the Southern Forest Experiment Station near Holly Springs, Marshall County, Miss. This type of structure, called the pole-frame brush dam, was rather extensively employed in that locality but has not been described heretofore and so far as is known has not been used elsewhere. The dam consists of a substantial anchor post set in midchannel to a depth of 24 to 36 inches, against which is laid a framework of poles backfilled on the upstream face with layers of brush boughs that filter out and retain the soil outwash. The downstream ends of the poles are overlapped at the anchor post, one on top of the other, much like the rails of an old-fashioned worm fence, while the other ends are notched well into the gully banks or are held in place with driven stakes or small posts. A typical pole-frame dam is illustrated in figure 1, and other essential details of construction are depicted in figures 2, 3, and 4.

Experience with this type of brush dam demonstrates that the poles of the framework should be sloped slightly toward the anchor post to provide a low center at the point of overfall. This tends to concentrate the flow and prevents the water from cutting around the ends of the dam. The poles do not need to be notched into each other at their junctures, with the exception of the two lowermost pairs of the framework, which should be fitted rather closely together in one plane to prevent undercutting and to hold the brush apron firmly in place. The pole framework may be bound to the anchor post with wire ties when very light poles are employed or where the character of flow requires an unusually strong dam. Experience at Holly Springs, however, indicates that wire anchorage is not highly essential and usually can be dispensed with, since the force of the run-off is directed so as to wedge the pole framework tightly against the anchor post and is seldom capable of floating poles of average dimensions. Furthermore, the soil deposits accumulating behind the dam also provide much additional weight and anchorage. Rough, tapering poles of any convenient size, including rather large logs, may be used, but those about 3 to 8 inches in diameter are easiest to cut and handle. They may be of pine or other softwood, although timbers of oak or other hardwoods are heavier and more durable.

This type of dam should not exceed about 18 inches in height at the center post or point of overfall. Higher dams may provide somewhat greater deposits of plantable soil, but they are much more likely to fail than are low dams and are almost always difficult to maintain. It should also be emphasized

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[2] See: (1) Ramser, C. E. Brief instructions on methods of gully control. U. S. Dept. Agr., Bur. Agr. Engin., 35 pp., mimeographed. August 1933. (2) U. S. Dept. Agr., Forest Service. Handbook of erosion control engineering on the national forests. 90 pp. 1936. (3) Ayres, Quincy Claude. Soil erosion and its control. 365 pp. McGraw-Hill Book Co. New York and London. 1936.

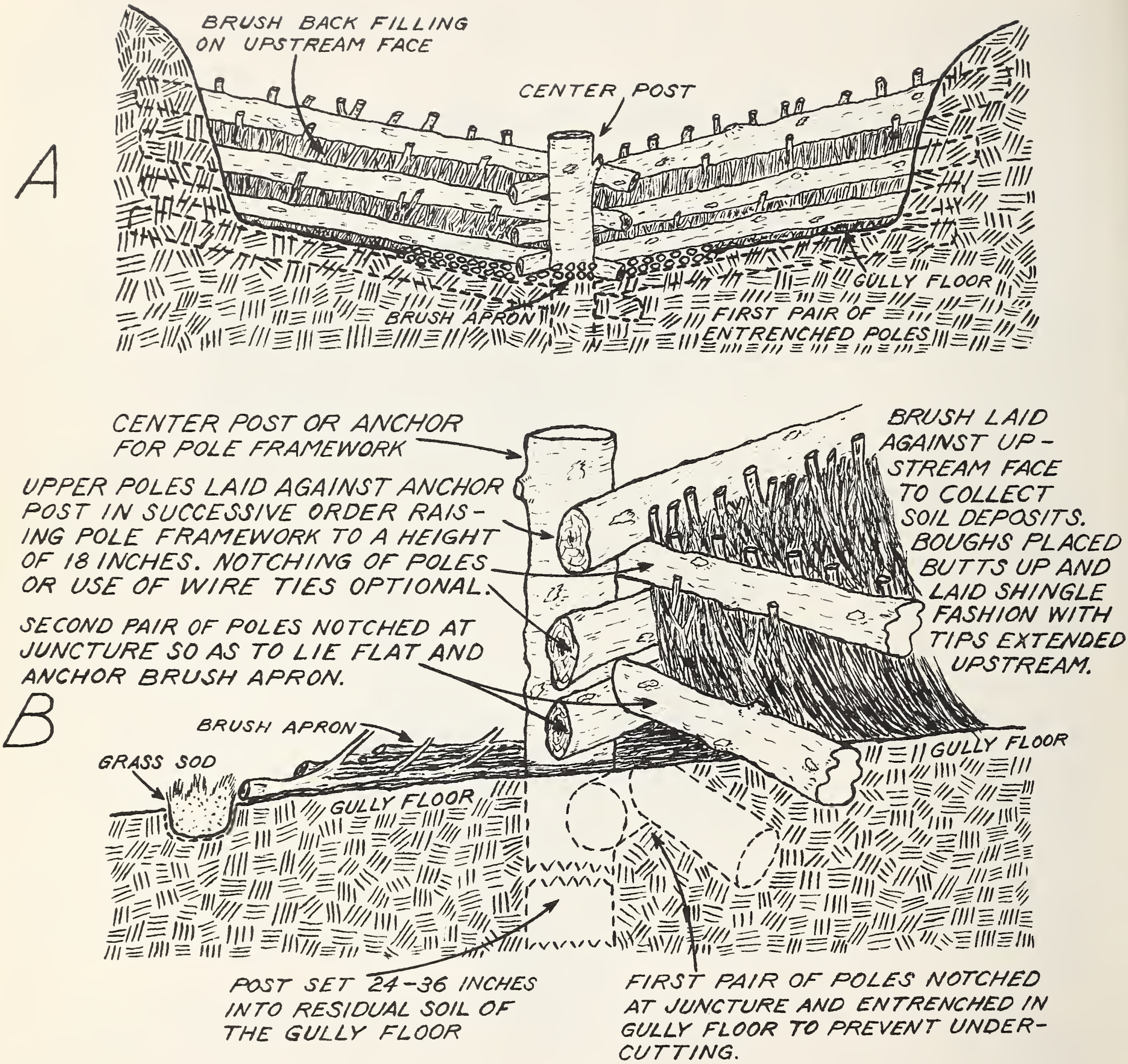


*Fig. 2 — Pole frame brush dam. (A) Downstream elevation showing poles sloped toward center of structure and with ends notched well into the banks of the gully. (B) Lateral section through mid channel, illustrating manner of laying pole framework against anchor post as well as other construction details.*

that since the pole-frame dam is not designed to operate as an overfall structure, the upstream face should not be backfilled with soil with a view to making the dam watertight. This is commonly done, but insofar as temporary brush dams are concerned, the practice has little to recommend it. It is not necessary to impound fully the run-off in order to collect ample deposits of soil, and a backfilling composed of permeable layers of brush will filter out the soil and gradually will build up a capacity deposit without subjecting the structure to the hazards that attend a watertight structure. The tendency to overlook this point frequently has resulted in the unnecessary failure of brush dams with consequent overemphasis on costly heavy-duty dams in situations where much simpler structures would suffice.

Of the materials commonly available for backfilling, pine tops or cedar boughs are usually best, although well-trimmed hardwood boughs, preferably cut with the leaves adhering, may be used effectively. The boughs should be overlapped in shingle-fashion on the gully floor with the tips extending upstream and the butts threaded through the openings and hooked into the pole framework. Straw, hay from wild grass, corn stover, sorghum bagasse, or other types of farm wastes make excellent backfilling for dams; they may be used either alone or (preferably) in admixture with the brush.

Normally, the materials used in brush dams are cut from damaged, unthrifty or poorly formed trees, from unmerchantable tops, or from loppings. Usually all parts of a tree can be utilized efficiently in constructing this type of dam. With trees of pole size, the butt cuts are used as anchor posts or split into stakes, the trunk and larger limbs are used in the pole framework, and the smaller boughs as backfilling. The large, open-grown or otherwise poorly formed trees also can be used in their entirety, provided they are southern pines or easily split hardwoods. Trees of sapling size, 3 inches or larger in diameter, are also usable, and where they are plentiful, dams can be constructed more easily from them than from larger trees.

The use of an apron is optional, and this feature was omitted from the majority of pole-frame dams constructed at Holly Springs without appreciably affecting the quality of the performance. Little additional material is required, however, to construct a substantial apron, which provides an additional safeguard by preventing the dam from being undermined. The use of grass sod as a border for the apron (figs. 1, 2, and 3) is not highly essential but may be desirable where only brush backfilling is used or in situations where drainage waters from above are not likely to bring in waste seed from native or domestic plants. Of the species grown in the Gulf States, Bermuda grass (<u>Cynodon dactylon</u> Pers.) is the most aggressive and best suited for protecting the base of check dams. The sods need not be spaced as closely as illustrated in figure 1; sods 1 foot apart are amply close.

At Holly Springs, pole-frame dams have been used successfully in all types of gullies common to the loessal uplands and adjoining Coastal Plain, and under the conditions found here they have proved quite dependable. Although they utilize the same kind of materials and in smaller amounts than is required in the Maddox type of dam, pole-frame dams are stronger and more dependable in channels carrying relatively heavy stormflow. Furthermore, this kind of dam with only minor changes can be adapted readily to suit local needs. In small, relatively quiescent washes, a very simple framework of short poles, backed by a small quantity of brush boughs, will suffice. By using heavier,

VIEW FROM ABOVE

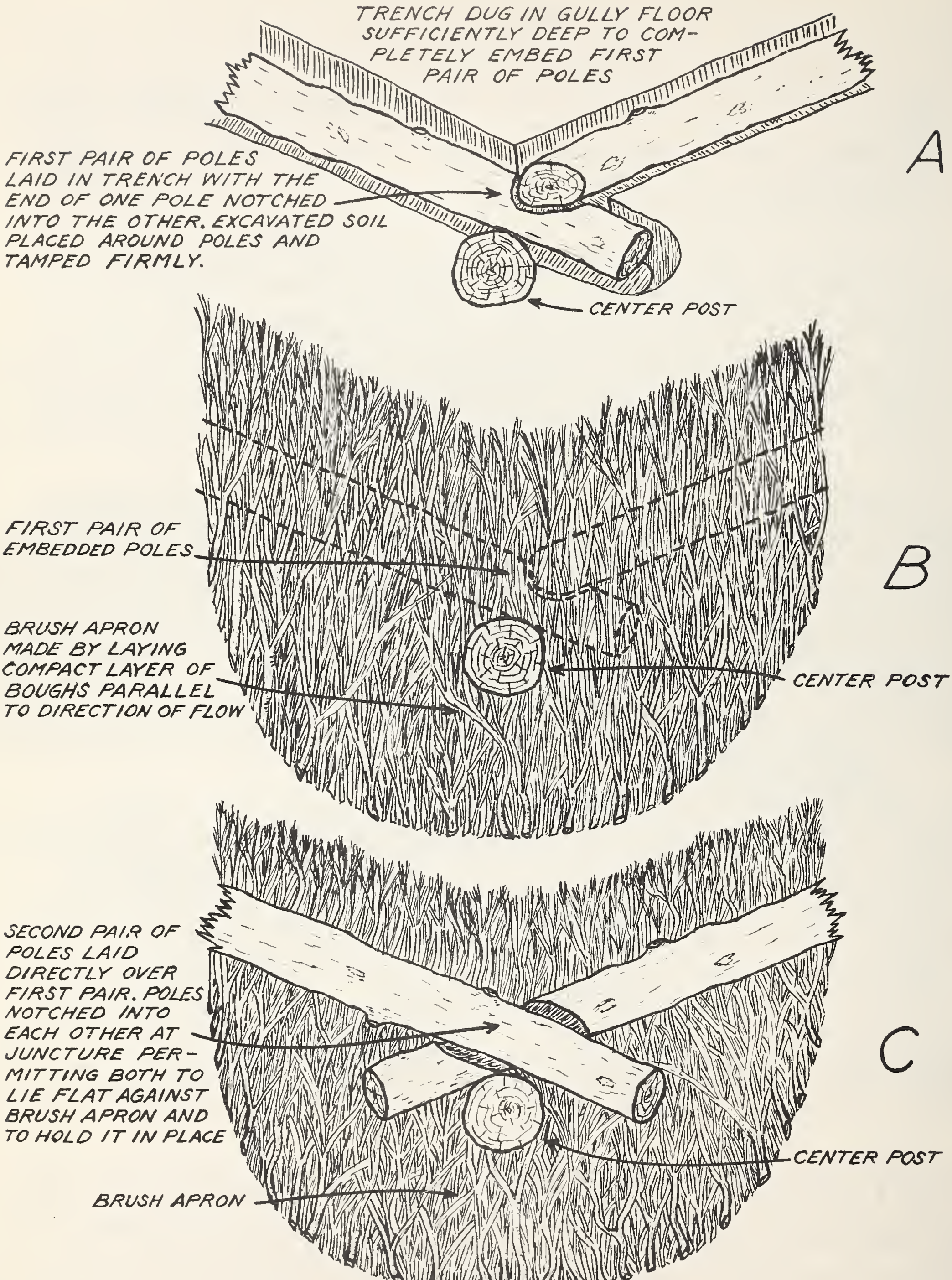


*Fig. 3 – Steps entailed in constructing the foundation for a pole-frame dam: (A) First pair of poles entrenched in the gully floor; (B) Placing boughs for a brush apron; (C) Second pair of poles notched at juncture and laid over brush apron.*

more durable material or by making minor modifications in construction (fig. 4), this type of dam can be used effectively also in the very large laterally extended gullies that are characteristic of this region. So far as is known, these dams have not been used in finger gullies draining steep mountainous slopes comparable to those of the Southern Appalachian Region, and their performance under such conditions is problematical; they have been successfully used, however, in the more steeply inclined scouring channels representative of the gullies in the Upper Coastal Plain. In very narrow v-profile gullies, the pole-frame dam probably can be constructed with less expenditure of labor than any other common type of brush dam of equal dependability.

Perhaps the outstanding feature of pole-frame dams is their nominal cost. Virtually the entire cost in building any brush dam is for the labor expended in cutting, trimming, and placing the brush and in providing suitable anchorage. Experience at Holly Springs indicates that the pole-frame dam requires less brush than the two more popular types of brush dams mentioned above and that a further saving is effected by the efficient mode of anchorage employed, which necessitates the setting of relatively few posts or stakes. Cost records obtained in 1934 and 1935 show that 426 pole-frame dams constructed in typical gullies required an average of only 1.13 man-hours of labor per dam. These structures were built in channels 3 to 20 feet wide (average about 7 feet). Using similar, although better-supervised, labor, some 77 brush dams of the longitudinal and double-post-row, crosswise types were constructed in comparable gullies with a total labor output of 533 man-hours or 6.92 man-hours per unit. In short, one man was able to construct a pole-frame dam in about one hour, whereas almost a day of labor was required to build a dam of the other two types. The labor output for building the latter two types of dam on this particular job was probably not excessive, inasmuch as Ayres[3] cites data indicating that the average labor requirements for building these structures range from 1 to 1.5 man-hours per linear foot of dam.

Although other kinds of temporary brush dams possess their good points and have special applications, experience with the pole-frame dam prompts the belief that this type comes most closely to fulfilling an all-around need for a cheap, dependable structure that can be used in reforesting gullied land in the Gulf States. Owing to its low cost and adaptability to a wide range of gully types, the pole-frame dam should find ready application in the South and in other comparable regions where the low value of gullied lands and other circumstances may justify a minimum of expenditures for control measures.

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3/ Ayres, Quincy Claude. Soil erosion and its control. (p. 221) McGraw-Hill Book Co. New York and London. 1936.

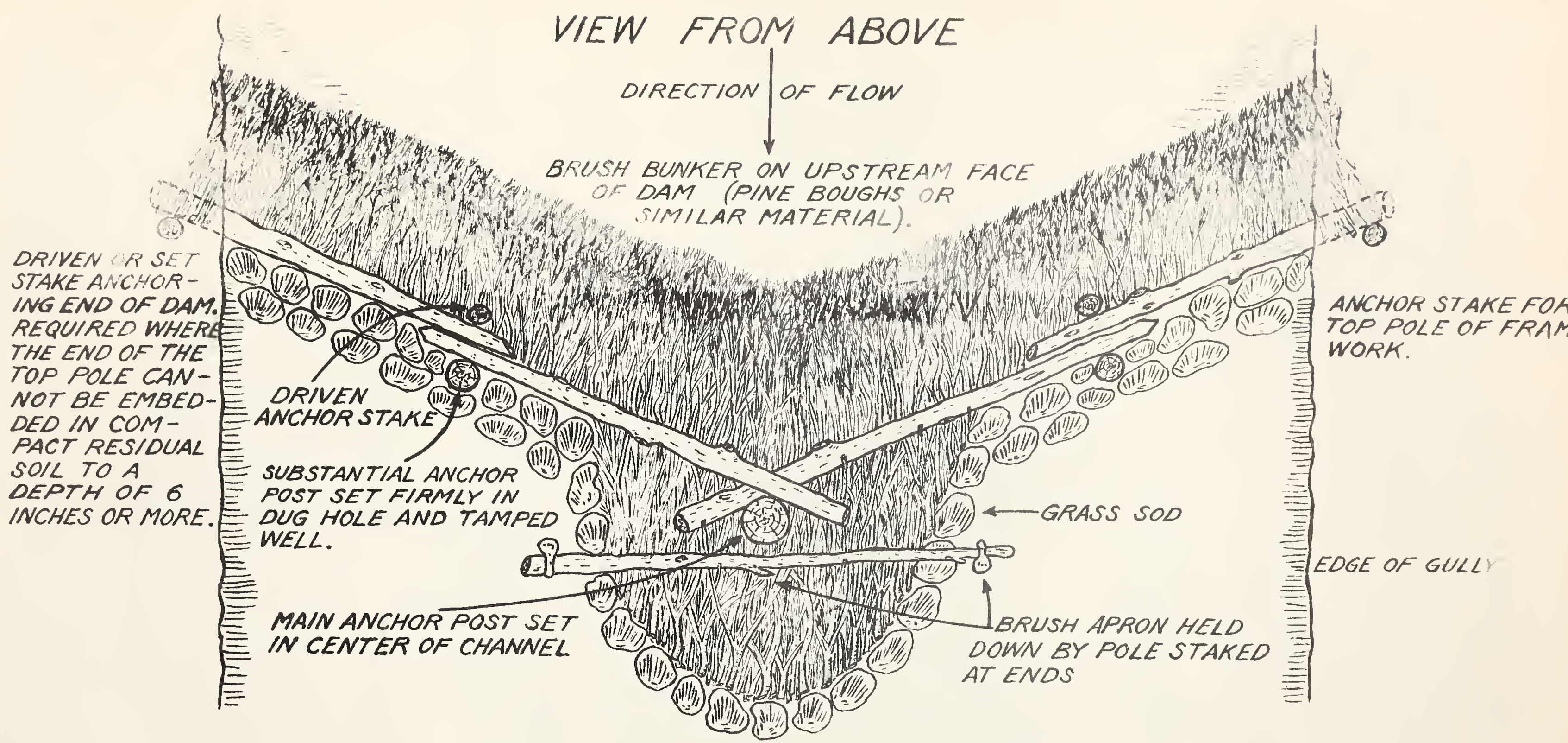


Fig. 4 – Method of constructing pole-frame dam in wide washes or in situations requiring the use of poles too short to extend from center to edge of the channel. The ends of the poles are overlapped about 2 feet and are held in place by a substantial post set firmly on the downstream face of the structure and by a hardwood stake driven opposite on the upstream face. Post and stake extend above ground sufficiently to anchor topmost poles of the framework. The brush apron and anchor pole are optional but may be needed to protect the base of large dams constructed in drainages carrying heavy flows. The dam can be made stronger by setting additional stakes or posts against the pole framework, by using wire ties and heavy poles, and providing a larger quantity of brush back filling.